CLAIMS

[1] A radio communications apparatus for simultaneously transmitting a local oscillation signal used when an intermediate frequency band signal is converted to a radio frequency band signal by a mixer unit, and the radio frequency band signal, comprising:

control means for changing a modulation scheme in accordance with the quality of communication and controlling an output power of the local oscillation signal.

[2] The radio communications apparatus according to claim 1, wherein said control means has detecting means for detecting the quality of communication, and means for changing the modulation scheme and controlling the output power of the local oscillation signal in accordance with the detected quality of communication.

[3] The radio communications apparatus according to claim 1, wherein the quality communication is a bit error rate of a received signal.

[4] The radio communications apparatus according to claim 1, wherein said mixer unit can control an output power of the local oscillation signal under the control of said control means.

[5] The radio communications apparatus according to claim 4, wherein said mixer unit has two mixers each supplied with the intermediate frequency band signal and the local oscillation signal for delivering the radio frequency band signal and the local oscillation signal; and a combiner for

combining the radio frequency band signals and the local oscillation signals supplied from said two mixers, respectively,

wherein said control means controls the phases of the local oscillation signals delivered from said two mixers.

[6] The radio communications apparatus according to claim 4, wherein:

said mixer unit has a first power splitter for splitting the local oscillation signal with equal amplitude and phase difference α; a second power splitter for splitting the intermediate frequency band signal with equal amplitude and phase difference β; a first and a second mixers each for mixing the local oscillation signal split by said first power splitter with the intermediate frequency band signal split by said second power splitter; and a combiner for combining the radio frequency band signals and the local oscillation signals delivered from said first and second mixers, respectively, with equal amplitude and phase difference γ,

wherein a value of $\alpha + \beta$ is controlled by said control means under a relationship of:

$$\alpha - \beta + \gamma = 2n\pi \text{ (n is an integer).}$$

[7] The radio communications apparatus according to claim 4, wherein said mixer unit has:

a first power splitter for splitting the local oscillation signal with equal amplitude and phase difference α;

a first phase shifter for changing the phase of one signal delivered from said first power splitter by δ;

a second power splitter for splitting the intermediate frequency band signal with equal amplitude and phase β;

a second phase shifter for changing the phase of one signal delivered from said second power splitter by φ;

a first mixer for mixing the local oscillation signal delivered from said first phase shifter with the intermediate frequency band signal delivered from said second phase shifter;

a second mixer for mixing the local oscillation signal split by said first power splitter with the intermediate frequency band signal split by said second power splitter;

a third phase shifter for changing the phase of a radio frequency band signal delivered from said first mixer by ψ; and

a combiner for combining a radio frequency band signal delivered from said third phase shifter and a radio frequency band signal generated from said second mixer with equal amplitude and phase γ,

wherein a value of $(\alpha + \delta) + (\gamma + \psi)$ is controlled by said control means under a relationship of:

$$(\alpha + \delta) - (\beta + \varphi) + (\gamma + \psi) = 2n\pi \text{ (n is an integer).}$$

[8] The radio communications apparatus according to claim 7, wherein all said first to third phase shifters comprise a plurality of phase

shifters having different phase shifting amounts from one another, and are each configured to select one of the plurality of phase shifters under the control of said control means,

wherein a value of $(\alpha + \delta m) + (\gamma + \psi m)$ is controlled by said control means under a relationship of:

$$(\alpha + \delta m) - (\beta + \varphi m) + (\gamma + \psi m) = 2n\pi \text{ (n is an integer)}$$

where δm, φm, ψm represent phase shifting amounts of respective selected phase shifters.

[9] The radio communications apparatus according to claim 4, wherein said mixer unit has:

a first power splitter for equally splitting the local oscillation signal with phase difference $\alpha 2$;

a second power splitter for equally splitting the intermediate frequency band signal with phase difference $\beta 2$;

a first and a second mixer each for mixing the local oscillation signal delivered from said first power splitter with the intermediate frequency band signal delivered from said second power splitter; and

a power combiner for combining a radio frequency band signal generated from said first mixer and a radio frequency band signal generated from said second mixer with equal power and phase difference $\gamma 2$,

wherein a DC bias to said mixer is controlled by said control means under a relationship of:

$\alpha 2 + \beta 2 + \gamma 2 = 2n\pi$ and $\alpha 2 - \beta 2 + \gamma 2 = (2n + 1)\pi$ (n is an integer).

[10] The radio communications apparatus according to claim 4, wherein said mixer unit has:

a first power splitter-for splitting the local oscillation signal into two;

a second power splitter for splitting the local oscillation signal split by said first power splitter with equal amplitude and phase difference $\alpha 4$;

a third power splitter for splitting the intermediate frequency band signal with equal amplitude and phase difference $\beta 4$;

a first and a second mixer each for mixing the local oscillation signal delivered from said second power splitter with the intermediate frequency band signal delivered from said third power splitter;

a first power combiner for combining radio frequency band signals generated from said first and second mixers with equal amplitude and phase difference $\gamma 4$;

an amplitude/phase control circuit capable of controlling the phase and amplitude of the other signal delivered from said first power splitter; and

a second power combiner for combining a local oscillation signal delivered from said amplitude/phase control circuit and a radio frequency band signal generated from said first power combiner,

wherein the amplitude and phase of said amplitude/phase control

circuit are controlled by said control means under a relationship of:

$$\alpha 4 + \beta 4 + \gamma 4 = 2n\pi \text{ and } \alpha 4 - \beta 4 + \gamma 4 = (2n + 1)\pi \text{ (n is an integer).}$$

[11] The radio communications apparatus according to claim 4, wherein said mixer unit has:

a first power splitter for splitting the local oscillation signal with equal distribution an phase difference $\alpha 3$;

a second power splitter for splitting the intermediate frequency band signal with equal distribution and phase difference β;

a first and a second mixer each for mixing the local oscillation signal delivered from said first power splitter with the intermediate frequency band signal delivered from said second power splitter; and

a power combiner for combining radio frequency band signals generated from said first and second mixers with equal power and phase difference γ,

wherein the frequency of said local oscillation signal is 1/m of the frequency of radio frequency band signal, and a value of $m x \alpha 3+\gamma$ is controlled by the control signal under a relationship of:

$$m \times \alpha 3 - \beta + \gamma = 2n\pi \text{ (n is an integer).}$$

[12] A radio communication method for simultaneously transmitting a radio frequency band signal and a local oscillation signal used when an intermediate frequency band signal is converted to the radio frequency band signal, said method comprising:

a modulation scheme changing control step for changing a modulation scheme in accordance with the quality communication; and

a step for controlling an output power of the local oscillation signal in accordance with the quality of communication.

[13] The radio communication method according to claim 12, wherein said quality of communication is a bit error rate of a received signal.

[14] A program for causing a computer to execute a radio communication method for simultaneously transmitting a radio frequency band signal and a local oscillation signal used when an intermediate frequency band signal is converted to the radio frequency band signal, said program comprising:

processing for changing a modulation scheme in accordance with a quality of communication ; and

processing for controlling an output power of the local oscillation signal in accordance with the quality of communication.

[15] A mixer unit in a radio communications apparatus for simultaneously transmitting a radio frequency band signal and a local oscillation signal used when an intermediate frequency band signal is converted to the radio frequency band signal, said mixer unit characterized in that:

an output power of the local oscillation signal can be controlled by a control signal in accordance with a quality of communication.

[16] The mixer unit according to claim 15, comprising:

two mixers each supplied with the intermediate frequency band signal and the local oscillation signal for delivering the radio frequency band signal and the local oscillation signal; and

a combiner for combining the radio frequency band signals and the local oscillation signals supplied from said two mixers, respectively,

wherein the phases of the local oscillation signals delivered from said two mixers are controlled by the control signal.

[17] The mixer unit according to claim 15, comprising:

a first power splitter for splitting the local oscillation signal with equal amplitude and phase difference α;

a second power splitter for splitting the intermediate frequency band signal with equal amplitude and phase difference β;

a first and a second mixers each for mixing the local oscillation signal split by said first power splitter with the intermediate frequency band signal split by said second power splitter; and

a combiner for combining the radio frequency band signals and the local oscillation signals delivered from said first and second mixers, respectively, with equal amplitude and phase difference γ,

wherein a value of $\alpha + \gamma$ is controlled by the control signal under a relationship of:

$$\alpha - \beta + \gamma = 2n\pi \text{ (n is an integer).}$$

[18] The mixer unit according to claim 15, comprising:

a first power splitter for splitting the local oscillation signal with equal amplitude and phase difference α;

a first phase shifter for changing the phase of one signal delivered from said first power splitter by δ;

a second power splitter for splitting the intermediate frequency band signal with equal amplitude and phase β;

a second phase shifter for changing the phase of one signal delivered from said second power splitter by φ;

a first mixer for mixing the local oscillation signal delivered from said first phase shifter with the intermediate frequency band signal delivered from said second phase shifter;

a second mixer for mixing the local oscillation signal split by said first power splitter with the intermediate frequency band signal split by said second power splitter;

a third phase shifter for changing the phase of a radio frequency band signal delivered from said first mixer by ψ; and

a combiner for combining a radio frequency band signal delivered from said third phase shifter and a radio frequency band signal delivered from said second mixer with equal amplitude and phase γ,

wherein a value of $(\alpha + \delta) + (\gamma + \psi)$ is controlled by said control means under a relationship of:

$$(\alpha + \delta) - (\beta + \varphi) + (\gamma + \psi) = 2n\pi \text{ (n is an integer).}$$

[19] The mixer unit according to claim 15, wherein:

all said first to third phase shifters comprise a plurality of phase shifters having different phase shifting amounts from one another, and are each configured to select one of the plurality of phase shifters under the control of the control signal,

wherein the value of $(\alpha + \delta m) + (\gamma + \psi m)$ is controlled by said control signal under a relationship of:

$$(\alpha + \delta m) - (\beta + \varphi m) + (\gamma + \psi m) = 2n\pi \text{ (n is an integer)}$$

where δm, φm, ψm represent the phase shifting amounts of respective selected phase shifters.

[20] The mixer unit according to claim 15, comprising:

a first power splitter for equally splitting the local oscillation signal with phase difference $\alpha 2$;

a second power splitter for equally splitting the intermediate frequency band signal with phase difference $\beta 2$;

a first and a second mixer each for mixing the local oscillation signal delivered from said first power splitter with the intermediate frequency band signal delivered from said second power splitter; and

a power combiner for combining a radio frequency band signal generated from said first mixer and a radio frequency band signal generated from said second mixer with equal power and phase difference $\gamma 2$,

wherein a DC bias to said mixer is controlled by the control signal under a relationship of:

$$\alpha 2 + \beta 2 + \gamma 2 = 2n\pi \text{ and } \alpha 2 - \beta 2 + \gamma 2 = (2n+1)\pi \text{ (n is an integer).}$$

[21] The mixer unit according to claim 15, comprising:

a first power splitter for splitting the local oscillation signal into two;

a second power splitter for splitting the local oscillation signal split from said first power splitter with equal amplitude and phase difference $\alpha 4$;

a third power splitter for splitting the intermediate frequency band signal with equal amplitude and phase difference $\beta 4$;

a first and a second mixer each for mixing the local oscillation signal delivered from said second power splitter with the intermediate frequency band signal delivered from said third power splitter;

a first power combiner for combining radio frequency band signals generated from said first and second mixers with equal amplitude and phase difference $\gamma 4$;

an amplitude/phase control circuit capable of controlling the phase and amplitude of the other signal delivered from said first power splitter; and

a second power combiner for combining the local oscillation signal delivered from said amplitude/phase control circuit and a radio frequency band signal generated from said first power combiner,

wherein the amplitude and phase of said amplitude/phase control circuit are controlled by said control means under a relationship of:

$\alpha 4 + \beta 4 + \gamma 4 = 2n\pi$ and $\alpha 4 - \beta 4 + \gamma 4 = (2n+1)\pi$ (n is an integer).

[22] The mixer unit according to claim 15, comprising:

a first power splitter for equally splitting the local oscillation signal with phase difference $\alpha 3$;

a second power splitter for equally splitting the intermediate frequency band signal with phase difference β;

a first and a second mixer each for mixing the local oscillation signal delivered from said first power splitter with the intermediate frequency band signal delivered from said second power splitter; and

a power combiner for combining radio frequency band signals generated from said first and second mixers with equal power and phase difference γ,

wherein the frequency of said local oscillation signal is $1/m$ of the frequency of the radio frequency band signal, and the value of $m x \alpha 3+\gamma$ is controlled by the control signal under a relationship of:

$m \times \alpha 3 - \beta + \gamma = 2n\pi$ (n is an integer).